MICHIGAN ENVIRONMENTAL SCIENCE BOARD

HYDROGEN SULFIDE PANEL MEETING SUMMARY
THURSDAY, AUGUST 13, 1998
RAMADA INN EXECUTIVE MEEETING ROOM
125 HOLIDAY LANE
HOWELL, MICHIGAN

PANEL MEMBERS PRESENT
Dr. Lawrence J. Fischer, Chair
Dr. John A. Gracki
Dr. David T. Long
Mr. Keith G. Harrison, Executive Director

DEQ/OSEP SUPPORT STAFF PRESENT
Mr. Jesse Harrold, Environmental Officer
Ms. Patricia Hiner, Executive Secretary
Ms. Evelyn L. Thomas, Graduate Student Intern

I. CALL TO ORDER

Dr. Lawrence J. Fischer, Chair, called the meeting to order at 9:03 am.

II. EXECUTIVE DIRECTOR'S UPDATE

Mr. Keith Harrison, Executive Director, discussed the material that had been made available to the Panel in the meeting packets and briefly discussed the literature that had been distributed to date. He also indicated there would be a brief presentation of a preliminary evaluation of some raw data regarding hydrogen sulfide and health complaints that had been requested at the last meeting.

III. PUBLIC COMMENT

John Griffen (American Petroleum Institute - API) presented a letter regarding studies that the API began in 1995, and that would conclude at the end of 1998. These studies, using the Chemical Industry Institute of Toxicology (CIIT) as the contractor, deal with the health effects of low level H_2S exposure. Mr. Griffen stated indicated that he would provide to the Panel with whatever preliminary information he could from the study.

Jim Stark (Michigan Oil and Gas Association) mentioned that his association and the Shell Oil Company would be conducting a tour of the Manistee 23 Gas Plant, a sour gas processing facility, on September 2, 1998. He admitted that this was somewhat outside the charge given to the Panel, but invited anyone who was interested to come on the tour.

Mr. Harold Fitch (Michigan Department of Environmental Quality, Geological Survey Division - MDEQ, GSD) encouraged the Panel to investigate the basis for the Nebraska regulation to determine whether it was based on science or regulatory and risk

management concerns.

Mr. Stark stated that he was speaking for the oil and gas industry in requesting that the Panel, in recommending safe levels of H_2S, come up with a number that was safe but not ridiculous. Mr. Harrison reminded the audience that it was not the charge of the MESB to come up with any particular regulatory number. Rather, the Governor charged the MESB to review the literature and come up with a range of values that would be protective of public health. Also, it was important to keep in mind that once the MESB fulfills the Governor's request, what will be done with the generated information will be up to the MDEQ.

Mr. Marco Bianchi (MDEQ) indicated that the information previously provided to the Panel by the MDEQ regarding the air toxics rules included a rationale as to how the MDEQ had come up with the screening levels, and why it had selected the U.S. Environmental Protection Agency (USEPA) reference concentrations.

IV. PRESENTATIONS

Mr. Greg Edwards (MDEQ, Air Quality Division - AQD) spoke on how the AQD works with the GSD on the issue of H_2S. He stated that the GSD had been in existence since 1939. It was charged at that time to both promote development of oil and gas and to protect the environment. Environmental concerns did not become an issue until the late 1960's with the Federal Clean Air Act. The state Act went into effect in 1965.

Concern about H_2S was raised in the early 1970's. A committee of personnel from the GSD and the AQD, which was at that time part of the then Michigan Department of Public Health, and others examined how H_2S should be managed at oil and gas facilities. The committee published a report in 1977 outlining what it felt should be done. The big concern was the distance that the wells should be placed from other facilities. Although the AQD had argued that a 1,000 foot setback was needed, 300 feet was established as the minimum setback distance.

A major revision to the administrative rules for pollution control went into effect in 1980. There is now a specific rule from the GSD that states that H_2S cannot just be emitted; it must be controlled. The main focus of this rule was sweetening facilities such as the Manistee 23 Gas Plant. Due to the difficulties experienced by the industry in being regulated by two agencies, the GSD and the AQD came up with a Memorandum of Understanding that divided the regulatory responsibilities. The GSD would be responsible for the regulation of the oil and gas sites; the wells and associated equipment. The AQD would be responsible for monitoring the sweetening facilities. Around this time the GSD began revisions to its regulations and developed a section addressing H_2S management.

Dr. Fischer questioned whether sweetening facilities were the major source of H_2S exposure. Mr. Edwards stated that, in his opinion, they were not. He indicted that the major source would be the oil and gas wells because there were several hundreds of those. There are 30 or less operating sweetening facilities. Given the current permitting requirements, few new sweetening facilities are being constructed. He

added that permitting is not designed to eliminate odors all together because that is not possible. Rather, the goal is to minimize the duration and the intensity of the odors.

Dr. Fischer asked if the GSD had proposed a new setback requirement. Mr. Fitch clarified that the minimum setback distance for wells was 300 feet, as it had been previously. However, the minimum setback for a certain class of surface equipment was now 600 feet. This was the highest class, with a Class II needing to be 450 feet from residences. These were minimum requirements with negotiations undertaken for each application received to get the best, farthest setback possible. Mr. Harrison questioned whether these requirements had a modeling basis which considered H_2S dispersal in the atmosphere. Mr. Fitch answered that there was a simple analytical model for classifying wells.

Mr. Stark stated that the greatest chance of accidental release is during the actual drilling of the wells. After the well is in place, an accidental release will most likely come from the tank battery facility, for which the setback distance has been increased. He added that setback is also related to the orderly development of oil fields. He stated that the rights of the mineral owners also are taken into consideration.

Mr. Fitch noted that accidental releases, although a possibility, are rare. More common are releases in small volumes, which cause a nuisance odor. The MDEQ is interested in determining what rules, if any, are needed to prevent health effects from these small volume releases. Eliminating risk from a worst case accident was not the objective for the request of this investigation. There is also a practicable aspect to consider. Increasing the isolation distance from wells much beyond 300 feet could reach the point of eliminating development.

Mr. Steve Kish (MDEQ, AQD) presented a background discussion on air dispersion modeling data for H_2S. Modeling done by the AQD often uses the industrial source complex (ISC) model that is characterized by Gaussian distribution, a bell shaped curve where the concentrations diminish going away from the center of the plume. This model is used during the permitting process and for odors and contained demonstrations. Also, there are now several dense gas models to help with the new accidental release regulation from 112R of the Clean Air Act. One such model is SLAB (an atmospheric dispersion model for denser-than-air releases) which is available for free from the USEPA's website. SLAB was developed in California by the Lawrence Livermore National Laboratory. The SLAB model handles four types of sources; evaporating pool, horizontal or vertical jet and instantaneous ground based pool. Another program, Areal Locations of Hazardous Atmospheres (ALOHA), is provided by the National Safety Council. It is used mostly by emergency response and fire department personnel to respond to accidental releases.

Hydrogen sulfide is considered a dense gas if it is under pressure. When H_2S is released it cools off and becomes dense. Dense gases tend to stay low and spread out under the force of gravity. There is transient dense gas from an instantaneous puff release where the cloud would first be immobile and then be carried downwind. Sources to be considered for this would be stacks, point sources, area sources such as roads or lagoons and evaporation from ponds. There are also volume sources such as

rough monitors at steel mills where pollutants emanate without excess velocity.

The SLAB model is based on the physical properties of the chemical under consideration. Setting parameters for the model involves setting up a receptor grid including building dimensions, terrain heights for the receptors, roughness of the terrain and source area. There is an urban and a rural classification. Meteorological data from the closest national weather service station are used, with conditions such as wind speed and temperature noted. The computer runs different hourly observations and finds the maximum concentration using the weather data. Different averaging times are used. For odor modeling, a ten minute average is used, which is derived by multiplying the one hour impact by two. That impact is then compared to odor thresholds. If there is a mixture of odor compounds, an odor panel study can be done where a sample of the gas is diluted to the threshold level. This equates to one odor unit. Usually, if the impacts are around one odor unit, a problem is not expected. At three to five odor units, there could be nuisance problem.

The toxics rule, Rule 230, has a screening level for H_2S that is health based. The standard is one microgram per cubic meter on a 24 hour average. Sources that emit H_2S need to demonstrate that they will be below that impact before they can get their permit. Meeting threshold limits for odors are not required. However, if a facility shows 10, 20, or 30 odor units, a closer look will be taken before a permit is issued.

The models use stabilities to determine impact concentrations. In the daytime when there is a lot of sun, there are unstable conditions, which are good for mixing the pollutants. At nighttime, there are more stable conditions and there is not much mixing. Temperature decreases as you go up in the atmosphere. When sunlight causes temperature increases, there are inversion conditions that can cause high levels of pollutant, trapping it and keeping it low to the ground. Neutral stability occurs most often with stable conditions occurring slightly less often. Unstable conditions occur least frequently. Lake effects also can influence prevailing winds. Records from 1992 show that in Lansing, there are primarily southwest prevailing winds. In Traverse City the winds are funneled by the bay. In Muskegon, there are different effects seen from the lake.

One model, which uses worst case meteorology, is called a SCREEN 3. Height of the stack is considered as well as the heat of the plume, which deals with thermal buoyancy, and thus dispersion rates. Mixing heights are set depending on whether it is an urban or a rural setting. Usually a stack test is done to determine emissions. However, sometimes published emission factors, which have been determined by the USEPA for different source categories, will be used. Pollutant concentrations are assumed to decrease with distance from the source. Screen levels combine the average 24-hour concentration with an appropriate setback distance to protect public health.

Recently, a model was developed that considers an accidental, emergency release at a gas well. In a gas well rupture scenario with a horizontal jet at a 450 parts per million (ppm) initial concentration, high stability, and fairly high wind speeds, the concentrations would still be above the threshold for health effects at 600 feet. The assumed

threshold, as determined by the Occupational Safety and Health Administration, is around 10 ppm for occupational exposures. Different wind speeds, stability conditions, or release pressures would produce different results. Models such as these have been validated with some field studies, performing within 15 percent. The greatest difficulty and source of error are the determinations of mixing and air turbulence. For consideration of low level, more constant releases the ISC model would be more valuable. Averaging could be done to determine 10-minute or 24-hour concentrations. Dispersion rates would likely be different for the emergency releases with concentrations decreasing more gradually. Reactions or degradation of the gas is generally not considered in these models

The ALOHA model tends to be a little more conservative than the SLAB model when considering the same type of gas well. It attempts to show the area that would be above the level of concern. It also describes a confidence interval showing a 95 percent likelihood that the wind is going to keep the plume within the specified area.

Cases involving high exposures at well heads provide an example of the modeling that is available. When asked about other more low level type scenarios, Mr. Kish said that he would be able to provide the Panel with additional models.

Evelyn Thomas (MESB), provided a preliminary summary of H_2S complaint data that had been provided by the MDEQ. These data had been requested from the MDEQ to see if there was a correlation between reported health impact and H_2S levels. The information collected consisted of GSD reports of citizen complaints regarding the oil and gas industry, and the field work investigating these complaints. The reports were for a 20-year period, from 1979 to 1998. The vast majority of the reports dealt with odor complaints. In addition, some of the complainants reported health problems such as headache, nausea, and eye and skin irritation. However, less than one fifth of the complaints included any report of a health impact, making it difficult to relate this information to the charge given the Panel. In addition, most of the odors were not verified as being caused by H_2S. Less than one fifth of the reports included documentation of H_2S testing. There were very few complaints that both listed a health effect and had documented testing of H_2S levels.

While some of the complainants reported currently experiencing odor problems, others said that it had happened in the past or that it was a chronic, long-term problem. Less than half of the complaints were investigated on the same day that the problem was reported. Sometimes there was not an MDEQ staff person available to immediately investigate and quite often the complainant did not call at the time of the odor problem. Some of the people had called several government agencies to complain.

Mr. Fitch clarified that the GSD has a standard formalized procedure for handling complaints. If there was any indication of health impacts at the time of the call, then this would be noted on the complaint form. Callers were not specifically asked if they had suffered health effects. Historically, if health effects were mentioned, there was no formal medical evaluation that was reportable to the GSD. However, there is now a procedure in place where the Michigan Department of Community Health has agreed to do an evaluation of any health effects noted in conjunction with an odor complaint. Mr.

Fitch also noted that measurements of H_2S were often not recorded because they were below the measurement threshold. He stated that GSD staff carry a monitor with them for personal safety reasons, however, the monitors do not measure below one ppm.

IV. PANEL DISCUSSION

Dr. Long asked where other types of odor complaints, such as those about farms, might be directed. Mr. Harrison responded that most people tend to be more familiar with their local county health department and that is where they would most likely call first. They also might try the Michigan Department of Agriculture. Neither of these agencies have a program for systematically recording of odor complaints that are specifically H_2S based.

Responding to questions regarding the origin of H_2S charge to the MESB, Mr. Harrison indicated that individual state departments can recommend to the Governor that he request the MESB to conduct an investigation. In this case, the request originated with the MDEQ.

Dr. Fischer noted that there was a lack of reliable data on current ambient levels of H_2S. This will make it difficult to determine the actual exposure to the citizens of Michigan. Therefore, it will be necessary to start from a health basis and decide an ambient air concentration that is felt to be safe for the population. In response to a question regarding the usefulness of animal studies to address long-term exposure impacts, Dr. Fischer indicated that most animal studies use higher concentrations to see what effects will occur and may not be that useful. The studies referenced in Dr. Adi Pour's presentation did look at some animal studies, but none of these could demonstrate any permanent long-term effects from low level exposure to H_2S. He also noted that some available human studies indicate that people exposed to higher levels of H_2S do not always fully recover. The adverse effects of high doses are a result of the lack of oxygen, which can leave lasting effects.

Dr. Fischer continued by stating that knowing the mechanism by which H_2S causes damage at low levels could help to establish safe levels. The studies by Bhambhani suggested that the mechanism of damage was alteration of cytochrome oxidase and indicated that there were some effects in humans at fairly low-level exposures. But these are not irreversible effects. These results also might be different in people who already have breathing difficulties and are thus more susceptible.

Dr. Long asked the basis for the 0.0007 ppm 24-hour figure. Mr. Bianchi said that it was the number established by the USEPA as a reference concentration for H_2S. He stated that 0.0007 ppm equaled one microgram per cubic meter and was a 24-hour averaging time of exposures over a lifetime. When a facility is applying for an air permit, the monitored off-site concentrations would have to be below that. However, there can be peaks of higher concentrations as long as the 24-hour average is below the maximum level allowed. Dr. Fischer asked for the minimum levels at which H_2S can be monitored. Mr. Bianchi did not have this information. Dr. Gracki said that there was a test that could absorb the substance in question over a long period of time and thus concentrate it for measuring. However, this was not part of standard monitoring

equipment and still only went down to the range of several parts per billion. Mr. Kish stated that compliance with regulations was based on emission rates and computer modeling, rather than actual measurements at the perimeter of the facility.

It was questioned whether the Panel could wait to finish its investigation until after the API study was complete. Mr. Fitch mentioned that the GSD was currently promulgating rules for H_2S. They had hoped to incorporate the findings of the Panel in those rules, but time constraints would not now allow that. However, limitation on concentrations of H_2S in the ambient air is a separate issue and could still be addressed, if need be, at a later time.

V. PANEL ASSIGNMENTS

Dr. Gracki stated that he had been looking at H_2S detection issues and that Dr. Wolff was looking at sources of H_2S. Dr. Long said that he had been looking at risk to Michigan citizens. Dr. Fischer stated that a review of where the exposure might be coming from was needed as part of the background information about this issue. He also said that he could take a look at the animal literature to see if there was any information regarding the mechanism that caused effects at low doses. In addition, he felt that the CIIT study would be useful as possible correlation of the data that had been received from Nebraska. Mr. Harrison commented that although concerns about the oil and gas industry had brought up this issue, other sources needed to be looked at for the investigation to be complete. He added that once the writing of the report began, it would become more clear where additional information would be needed.

VI. NEXT MEETING DATE

No additional meetings were scheduled.

VII. ADJOURNMENT

The meeting was adjourned at 11:27 AM.

Keith G. Harrison, M.A., R.S., Cert. Ecol.
Executive Director
Michigan Environmental Science Board